

WHAT IS CLAIMED IS:

1. A computer system for electronic intermediated exchange of a plurality of commodities among a plurality of participants
5 comprising:

a. one or more computer-based machines;

b. a plurality of e-agent computer programs running on at least one of said computer-based machines, wherein each said participant is associated with at least one of said
10 e-agent computer programs, and each said e-agent computer program stores in an electronic memory digital data representing commodity exchange objectives of its associated participant; and

c. an electronic intermediary computer program
15 running on at least one of said computer-based machines, wherein said intermediary computer program stores in an associated electronic memory digital data representing commodity exchange objectives of the intermediated exchange and exchanges electronic offer and electronic counter-offer
20 messages with said e-agent computer programs;

wherein (i) said e-agent computer programs receive said electronic offer messages from said intermediary computer program, generate said electronic counter-offer messages according to said exchange objectives of said associated
25 participants, and send said electronic counter-offer messages to said intermediary computer program, and (ii) said intermediary computer program receives said electronic counter-offer messages from said e-agent computer programs, generates said electronic offer messages according to said exchange
30 objectives of said intermediated exchange, and sends said electronic offer messages to said e-agent computer programs.

~~2. The computer system of claim 1 wherein said commodities are intangible commodities.~~

3. The computer system of claim 1 wherein said exchange of electronic messages between said intermediary computer program and said e-agent computer programs converges to an exchange of said commodities, that is substantially satisfactory both to
5 said e-agent computer programs, according to said digital data representing said commodity exchange objectives of said participants, and also to the intermediary computer program, according to said digital data representing commodity exchange objectives of the intermediated exchange.

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4. The computer system of claim 1 wherein said electronic offer messages contain digital data representing the amounts of said commodities that said intermediary computer program offers to said e-agent computer programs, and wherein said electronic
15 counter-offer messages contain digital data representing the amounts of said commodities that said e-agent computer programs accept from said intermediary computer program.

5. The computer system of claim 4 wherein said exchange of
20 electronic messages terminates when said e-agent computer programs generate electronic counter-offer messages accepting all the amounts of commodities offered in the immediately preceding electronic offer messages received from said intermediary computer program.

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6. The computer system of claim 4 wherein said e-agent computer programs generate electronic counter-offer messages accepting amounts of commodities that are less than or equal to the amounts offered in one or more of the preceding electronic
30 offer messages received from said intermediary computer program.

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7. The computer system of claim 6 wherein said one or more preceding intermediary computer program electronic offer messages is the immediately preceding electronic offer message.

5 8. The computer system of claim 4 wherein the e-agent computer programs and the intermediary computer program exchange messages according to sequential rounds of an electronic negotiation, each round of said negotiation comprising said intermediary computer program sending
10 electronic offer messages to said e-agent computer programs followed by said e-agent computer programs sending electronic counter-offer messages to said intermediary computer program.

9. The computer system of claim 8 wherein said electronic
15 memory associated with said intermediary computer program further stores digital data representing a plurality of current and preceding bounds, each said current bound representing the maximum amount of a particular commodity that can be offered to a particular e-agent computer program in a current round of
20 said electronic negotiation and each said preceding bound being a current bound from a preceding round of said electronic negotiation, and wherein said intermediary computer program generates electronic offer messages offering amounts of commodities less than or equal to the appropriate one of said
25 current bounds.

10. The computer system of claim 9 wherein said plurality of current bounds depends at least on commodity amounts in said intermediary electronic offer messages, said e-agent electronic
30 counter-offer messages, and said preceding bounds from one or more preceding rounds of said electronic negotiation.

11. The computer system of claim 10 wherein said one or more preceding rounds of said electronic negotiation is the immediately preceding round of said electronic negotiation.

5 12. The computer system of claim 9 wherein said plurality of current bounds depends at least on commodity amounts in said e-agent electronic counter-offer messages and on the preceding bounds from the immediately preceding round of said electronic negotiation.

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13. The computer system of claim 12 wherein said electronic memory associated with said intermediary computer program further stores digital data representing a selected round of said electronic negotiation, wherein before said selected round
15 of negotiation said plurality of current bounds are selected to be between commodity amounts in said e-agent electronic counter-offer messages and said preceding bounds of the immediately preceding round of said electronic negotiation, and wherein after said selected round of negotiation the plurality
20 of current bounds are selected to be equal to e-agent electronic counter-offer messages of the immediately preceding round of said electronic negotiation.

14. The computer system of claim 13 wherein before said
25 selected round of negotiation said plurality of current bounds are selected to be substantially a weighted average of the commodity amounts in said e-agent electronic counter-offer messages and said preceding bounds of the immediately preceding round of said electronic negotiation.

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15. The computer system of claim 1 wherein said e-agent computer programs further send electronic opening messages to said intermediary computer program before said exchange of electronic offer and counter-offer messages, each said

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electronic opening message including digital data representing maximum amounts of commodities each participant will exchange in said intermediated exchange.

5 16. The computer system of claim 1 wherein said electronic memory associated with said intermediary computer program further stores digital data representing a plurality of bounds on the selling or buying of each commodity by each e-agent computer program, and wherein said commodity exchange
10 objectives of said intermediary computer program comprise that a substantially maximized amount of commodities are exchanged in said intermediated exchange subject to constraints (i) that for each said commodity the total amount sold equals the total amount bought by all said e-agent computer programs, and (ii)
15 that for each commodity the amount sold or bought by each e-agent computer program is less than the appropriate one of said bounds.

17. The computer system of claim 16 wherein said commodity
20 exchange objectives of said intermediary computer program further comprise that a measure of the unfairness of the share of commodities offered to each e-agent computer program is substantially minimized.

25 18. The computer system of claim 17 wherein said measure of unfairness increases substantially as the share of commodities offered to each e-agent computer program differs from a pro-rata share.

30 19. The computer system of claim 18 wherein said measure of unfairness increases substantially as the square of the difference of the share of commodities offered to each e-agent computer program differs from a pro-rata share.

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20. The computer system of claim 18 wherein said pro-rata share for a commodity for an e-agent computer program depends at least on the ratio of said bounds for that commodity for that e-agent computer program to the sum of the bounds for that commodity for all the e-agent computer programs.

21. The computer system of claim 18 wherein said measure of unfairness includes a plurality of adjustable factors, each factor associated with an e-agent computer program and for adjusting the rate of increase of said measure of unfairness as the share of commodities offered to an e-agent computer program differs a pro-rata share.

22. The computer system of claim 1 wherein said electronic offer messages contain digital data representing the amounts of commodities offered to said e-agent computer programs, and wherein said intermediary computer program generates said commodity amounts for said electronic offer messages by substantially maximizing the value of a utility function of said amounts of commodities subject to constraints.

23. The computer system of claim 22 wherein said utility function comprises a difference of a first term and a second term, said first term representing the total amount of all commodities offered to said e-agent computer programs and said second term representing the unfairness of the share of commodities offered to said e-agent computer programs.

24. The computer system of claim 22 wherein one or more non-linear terms in said utility function is approximated by a plurality of piece-wise linear terms.

25. The computer system of claim 22 wherein said commodities are exchanged in whole commercial units, and wherein any

fractional commercial units generated by substantially maximizing the value of said utility function are reallocated among said e-agent computer programs in a substantially fair manner, whereby only whole commercial units of commodities are
5 actually offered.

26. The computer system of claim 1 wherein said electronic counter-offer messages contain digital data representing the amounts of said commodities that said e-agent computer programs
10 accept from said intermediary computer program, and wherein at least one of said e-agent computer programs generates electronic counter-offer messages by accepting all commodity amounts previously offered by said intermediary computer program and limited by pre-specified maximum commodity exchange
15 bounds and by optional constraints.

27. The computer system of claim 1 wherein said electronic counter-offer messages contain digital data representing the amounts of said commodities that said e-agent computer programs
20 accept from said intermediary computer program, and wherein at least one of said e-agent computer programs generates electronic counter-offer messages by executing a computer program that substantially maximizes the value of a utility function of said commodity amounts.

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28. The computer system of claim 27 wherein said utility function is determined according to mean-variance portfolio methods.

30 29. The computer system of claim 28 wherein said utility function comprises a difference of two terms, a first term representing the expected return from a portfolio having said commodity amounts and a second term representing the risk of a portfolio having said commodity amounts.

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30. The computer system of claim 27 wherein said maximization of said utility function is limited by optional constraints.

31. The computer system of claim 1 wherein said electronic counter-offer messages contain digital data representing the amounts of said commodities that said e-agent computer programs accept from said intermediary computer program, and wherein at least one of said e-agent computer programs for said associated participant generates electronic counter-offer messages by executing procedural rules having variables referring to said commodity amounts.

32. The computer system of claim 1 wherein at least one of said e-agent computer programs is provided by said associated participant.

33. The computer system of claim 1 wherein at least one of said e-agent computer programs is memory-less.

34. The computer system of claim 1 wherein at least one of said participants is associated with more than one e-agent computer programs.

35. The computer system of claim 1 wherein at least one of said e-agent computer programs is an autonomously running computer process.

36. The computer system of claim 1 wherein at least one of said e-agent computer programs are executed on the same computer-based machine as said intermediary computer program.

37. The computer system of claim 1 wherein at least one of said e-agent computer programs are executed on a computer-based

machine geographically remote from the computer-based machine on which said intermediary computer program is executed.

38. The computer system of claim 1 further comprising
5 communications means for sending digital information representing said electronic offer messages and said electronic counter-offer messages between said e-agent computer programs and said intermediary computer program.

10 39. The computer system of claim 38 wherein said communication means includes means functioning according to the IP or the TCP/IP communication protocols.

40. The computer system of claim 38 wherein said communication
15 means includes inter-process communication means of an operating system of one of said computer-based machines running at least one of said e-agent computer programs and said intermediary computer program.

20 41. The computer system of claim 38 wherein said communication means includes inter-computer communication means between at least two of said computer-based machines where said e-agent computer programs and said intermediary computer programs are executed.

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42. The computer system of claim 1 wherein said e-agent computer programs receive electronic order messages from computers of said associated participants, said electronic order messages containing digital data representing said
30 commodity exchange objectives of said associated participants, and wherein said intermediary computer program sends electronic results messages to said computers of said participants, said electronic results messages containing digital data representing the results of an intermediated exchange.

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43. The computer system of claim 42 wherein said digital data representing said commodity exchange objectives of said participants is tested before said electronic intermediated exchange begins.

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44. The computer system of claim 1 further comprising a supervisor computer program running on at least one of said computer-based machines, and wherein said supervisor periodically tests each computer program of said computer
10 computer system to determine if it has failed.

45. A method for an electronic intermediated exchange of a plurality of commodities among a plurality of participants comprising the steps of:

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a. sending a plurality of electronic offer messages generated by an intermediary computer program to a plurality of e-agent computer programs, each e-agent computer program associated with and representing one of said participants, each said electronic offer message including digital data

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representing amounts of commodities offered to said e-agent computer programs by said intermediary computer program;

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b. sending a plurality of electronic counter-offer messages generated by said e-agent computer programs to said intermediary computer program, each said electronic counter-offer message including digital data representing amounts of commodities accepted by said e-agent computer program; and

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c. repeating steps (a) and (b) until the amounts of commodities in said electronic offer messages are substantially satisfactory to said e-agent computer programs, according to exchange objectives of said participants stored as digital data accessible to said e-agent computer programs, and to said intermediary computer program, according to objectives for said intermediated exchange stored as digital data accessible to said intermediary computer program.

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46. The method of claim 45 wherein said electronic counter-offer messages generated by said e-agent computer programs represent accepted amounts of commodities that are less than or equal to amounts of commodities represented in one or more of
5 said preceding electronic offer messages received from said intermediary computer program.

47. The method of claim 46 wherein said one or more preceding electronic offer messages is the immediately preceding
10 electronic offer message.

48. The method of claim 45 wherein step (c) terminates when said e-agent computer programs generate electronic counter-offer messages representing acceptance of the total amounts of
15 commodities offered in the immediately preceding electronic offer messages received from said intermediary computer program.

49. The method of claim 45 wherein step (a) further comprises
20 said intermediary computer program, first, determining digital data representing a plurality of bounds, each said bound representing a maximum amount of a particular commodity that can be offered to a particular e-agent computer program in a current round of said electronic negotiation, and second,
25 generating said electronic offer messages representing offered amounts of commodities less than or equal to the appropriate one of said bounds.

50. The method of claim 49 further comprising before step (a)
30 a step of sending a plurality of electronic opening messages from said e-agent computer programs to said intermediary computer program, each said electronic opening message including digital data representing maximum amounts of commodities participants will exchange in said intermediated

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exchange, and wherein said intermediary determines said bounds initially to be said maximum amounts.

51. The method of claim 49 wherein said bounds in a later
5 round of said negotiation are not greater than said bounds in an earlier round of said negotiation.

52. The method of claim 49 wherein said plurality of bounds in
a current round of said negotiation depends on commodity
10 amounts represented in said intermediary electronic offer messages, said e-agent electronic counter-offer messages, and said bounds from one or more preceding rounds of said negotiation.

15 53. The method of claim 52 wherein said one or more preceding rounds of said negotiation is the immediately preceding round of said negotiation.

54. The method of claim 49 wherein said plurality of current
20 bounds depends at least on commodity amounts represented in said e-agent electronic counter-offer messages and on said bounds from the immediately preceding round of said negotiation.

25 55. The method of claim 54 wherein said plurality of bounds depends at least on a weighted average of commodity amounts represented in said e-agent electronic counter-offer messages and said bounds from the immediately preceding round of said negotiation.

30 56. The method of claim 55 wherein after a selected round of said negotiation said bounds are determined to be equal to commodity amounts represented in said e-agent electronic

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counter-offer messages from the immediately preceding round of said negotiation.

57. The method of claim 45 further comprising before step (a)
5 a step of sending from said intermediary computer program to said e-agent computer programs a plurality of electronic initial messages, each said electronic initial message including digital data representing the particular commodities that can be exchanged in said intermediated exchange.

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58. The method of claim 45 further comprising before step (a) a step of said e-agent computer programs receiving and storing a plurality of electronic order messages from said participants, each said electronic order message including
15 digital data representing said exchange objectives of that participant.

59. The method of claim 45 further comprising after step (c) a step of sending a plurality of electronic results messages to
20 each said participant, each said electronic results message including digital data representing the amounts of commodities in said satisfactory electronic offer message.

60. The method of claim 45 further comprising before step (a)
25 a step of said intermediary computer program receiving and storing electronic objective messages from an operator of said electronic intermediated exchange, each said electronic objective message including digital data representing said objectives of said intermediated exchange.

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61. A computer readable medium comprising encoded instructions for causing an electronic computer to function according to claim 45.

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62. A method for representing a participant in an intermediated exchange of commodities, said intermediated exchange performed by an electronic negotiation with an intermediary computer program, said method comprising:

- 5 a. receiving an electronic order message from a computer of said participant, said electronic order message including digital data representing the objectives of said participant for said intermediated exchange in order that e-agent computer program can represent said participant;
- 10 b. receiving one of a plurality of electronic request messages from said intermediary computer program; and
- c. sending one of a plurality of electronic response messages to said intermediary computer program in response to said previous electronic request message, said
15 electronic response message being
 - (i) an electronic opening message, if said previous electronic request message was a query for an electronic opening message, said electronic opening message including digital data representing the maximum amounts of
20 commodities that said e-agent computer program will exchange in said intermediated exchange, and
 - (ii) an electronic counter-offer message, if said previous electronic request message was an electronic offer message, said electronic offer message including digital
25 data representing amounts of commodities offered to said e-agent computer program by said intermediary computer program, said electronic counter-offer message including digital data representing amounts of commodities accepted by said e-agent computer program as determined according to said exchange
30 objectives, said accepted amounts being less than or equal to said offered amounts and being all equal to said offered amounts only if said offered amounts meet said exchange objectives.

63. The method of claim 62 further comprising, between steps (a) and (b), a step of exchanging one or more electronic initial messages between said e-agent computer program and said intermediary computer program, said electronic initial messages including digital data representing commodities of interest to said participant according to said exchange objectives as determined by said e-agent computer program, and commodities participating in said intermediated exchange with prices for said participating commodities as determined by said intermediary computer program.

64. The method of claim 62 wherein said exchange objectives are expressed as procedural rules which determine accepted amounts of commodities from offered amounts of commodities.

65. The method of claim 62 wherein said exchange objectives are expressed according to mean-variance portfolio theory.

66. The method of claim 65 wherein said exchange objectives are expressed as utility function of commodity amounts, and wherein accepted commodity amounts substantially maximize said utility function subject to maximum amount constraints given by said offered commodity amounts.

67. The method of claim 66 wherein said utility function includes terms representing expected return and expected risk.

68. A computer readable medium comprising encoded instructions for causing an electronic computer to function according to claim 62.

69. A computer readable medium comprising encoded instructions for causing an electronic computer to function according to claim 62.

70. A method for an intermediated exchange of commodities among a plurality of participants, each participant represented by an e-agent computer program, said method comprising:

- a. sending electronic opening messages to an
5 intermediary computer program from said e-agent computer programs, said electronic opening messages including digital data representing the maximum amount of each commodity that each e-agent computer program will exchange in said intermediated exchange;
- 10 b. sending electronic offer messages by said intermediary computer program to said e-agent computer programs, each said electronic offer message including digital data representing amounts of commodities currently offered to each e-agent computer program, said
15 amounts being determined so that for each commodity the amount being offered for sale by all the e-agent computer programs equals the amount being offered for purchase by all the e-agent computer programs;
- c. receiving electronic counter-offer messages by
20 said intermediary computer program from said e-agent computer programs, each said electronic counter-offer message including digital data representing amounts of offered commodities accepted by each said e-agent computer program, said accepted commodity amounts being less than or equal to said offered
25 commodity amounts;
- d. repeating steps (b) and (c), each repetition being a round of an electronic negotiation, until said e-agent computer programs accept all the amounts of commodities offered, said accepted amounts being final commodity amounts;
30 and
- e. sending results electronic messages to computers of said participants, said electronic results messages including digital data representing said final commodity amounts.

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71. The method of claim 70 further comprising before step (a), a step of exchanging one or more electronic initial messages between said intermediary computer programs and said e-agent computer programs, said electronic initial messages including 5 digital data representing commodities that said e-agent computer programs will exchange in said intermediated exchange, and commodities actually participating in said intermediated exchange with prices for said participating commodities.

10 72. The method of claim 70 wherein step (b) further comprises said intermediary computer program, first, determining digital data representing a plurality of bounds, each said bound representing a maximum amount of a particular commodity that can be offered to a particular e-agent computer program in a 15 current round of said electronic negotiation, and second, generating said electronic offer messages representing offered amounts of commodities that are less than or equal to said bounds.

20 73. The method of claim 72 wherein said intermediary determines said bounds initially to be said maximum amounts.

74. The method of claim 72 wherein said bounds in a later round of said negotiation are not greater than corresponding 25 bounds in an earlier round of said negotiation.

75. The method of claim 72 wherein said plurality of bounds in a current round of said negotiation depends at least on commodity amounts represented in said intermediary electronic 30 offer messages, said e-agent electronic counter-offer messages, and said bounds from one or more preceding rounds of said negotiation.

76. The method of claim 75 wherein said one or more preceding rounds of said negotiation is the immediately preceding round of said negotiation.

5 77. The method of claim 72 wherein said plurality of current bounds depends at least on commodity amounts represented in said e-agent electronic counter-offer messages and on said bounds from the immediately preceding round of said negotiation.

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78. The method of claim 77 wherein said plurality of bounds depends at least on a weighted average of commodity amounts represented in said e-agent electronic counter-offer messages and said bounds from the immediately preceding round of said
15 negotiation.

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79. The method of claim 78 wherein after a selected round of said negotiation said bounds are determined to be equal to commodity amounts represented in said e-agent electronic
20 counter-offer messages from the immediately preceding round of said negotiation.

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80. The method of claim 70 further comprising before step (a) a step of sending from said intermediary computer program to
25 said e-agent computer programs a plurality of electronic commodity messages, each said electronic commodity message including digital data representing the particular commodities that can be exchanged in said intermediated exchange.

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30 81. A computer readable medium comprising encoded instructions for causing an electronic computer to function according to claim 70.

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82. An order-manager computer system for electronic intermediated exchange of a plurality of commodities among a plurality of participants, said computer system comprising:

a. one or more computer-based machines;

5 b. a plurality of client-interface electronic processes running on one or more of said computer-based machines for communicating with computer-based machines of said participants in order to receive from said participants electronic order messages representing exchange objectives of
10 said participants and to send to said participants electronic results messages representing the commodities exchanged in said intermediated exchange;

c. an exchange-driver electronic process running on one of said computer-based machines for transferring said
15 electronic order messages and said electronic results messages between said client-interface processes and an intermediary electronic process;

d. an electronic database running on one of said computer-based machines for storing copies of said order and
20 said electronic results messages, and, in event of process failure in said order-manager computer system, for retrieving said message copies in order to restart said failed process; and

e. a plurality of e-agent electronic processes
25 running on one or more of said computer-based machines, each said e-agent process for representing one of said participants according to said exchange objectives by generating electronic counter-offer messages sent to said intermediary process in response to electronic offer messages received from said
30 intermediary process; wherein

f. said intermediary electronic process running on one of said computer-based machines for generating said electronic offer messages sent to said e-agent processes in response to said electronic counter-offer messages received

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from said e-agent processes, said exchange of offer and electronic counter-offer messages being according to a protocol for performing said intermediated exchange, and further for generating said electronic results messages when said
5 intermediated exchange completes.

83. The order-manager computer system of claim 82 further comprising communication means interconnection said computer-based machines.

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84. The order-manager computer system of claim 82 wherein said electronic offer messages and said electronic counter-offer messages include digital data representing amounts of commodities, and wherein according to said protocol (i) the
15 amounts of commodities represented in said electronic counter-offer messages are less than or equal to the amounts of commodities represented in immediately preceding corresponding electronic offer messages, and (ii) the amounts of commodities represented in said electronic offer messages are less than or
20 equal to the amounts of commodities represented in immediately preceding corresponding electronic offer messages.

85. The order-manager computer system of claim 82 wherein said intermediary process further comprises:

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a. a communications interface component for communicating messages between the intermediary process and the exchange driver process and the database;

b. an allocation component for performing the computations for generating said electronic offer messages; and

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c. a local data area component for storing data to be exchanged between said communication interface function and said allocation function.

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86. The order-manager computer system of claim 82 further comprising:

- a. a supervisor process running on one of said computer-based machines for periodically testing other processes of said order-manager computer system for failure, and in case of failure, for managing restart of said failed process; and
- b. a slave-supervisor process running on one of said computer-based machines for periodically testing said supervisor process for failure, and in case of failure, for assuming the functions of said supervisor process.

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add B' >

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ADD C4 >

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